

## Preface

Lieutenant General "Jimmy Doolittle" is most often remembered for his famed raid on Japan using B-25 aircraft launched from the deck of the Navy aircraft carrier *Hornet*; however, this amazing man's contributions to aviation hardly ended there. Besides being the first person to be awarded a Sc.D. in Aeronautical Science from the Massachusetts Institute of Technology, he was arguably the father of the discipline that is now called Avionics. He placed the first instrument flight equipment in an aircraft, performed the first long distance flight using instruments alone and even performed the first instrument approaches [ref. 58]. It seems likely; however, that even he could not have imagined the proliferation of avionics equipment in modern aircraft, particularly military aircraft.

Modern military aircraft rely heavily on highly complex electronic systems to make them effective weapons in a world filled with equally sophisticated counter systems. These components can add up to as much as 80% of the aircraft price tag. As new systems are developed, numerous tests are necessary to provide feedback in the iterative design process and to ensure that design parameters are met. Unfortunately, little has been written on the techniques for testing these systems. Even today, test pilot training programs stress aircraft performance and handling qualities testing while the majority of test work revolves around avionics testing. This book is an attempt to put in print the rudimentary knowledge necessary for a test pilot or engineer to develop and execute a cost effective and quick test of a modern avionics system.

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Le général "Jimmy Doolittle" est plus souvent connu pour son fameux raid sur le Japon à bord d'un B25 lancé du porte avions Hornet, cependant, la contribution de cet homme remarquable à l'aviation ne s'arrête pas là.

Non seulement première personne à avoir reçu un doctorat en sciences aéronautiques du MIT, il est sans conteste le père de cette discipline que l'on appelle maintenant l'avionique. Il a équipé un avion pour le vol aux instruments, effectué le premier vol longue distance en volant uniquement aux instruments et même effectué les premières approches aux instruments (ref 58). Il semble probable malgré tout qu'il n'aurait pu imaginer l'essor de l'avionique dans les avions modernes, particulièrement les avions d'armes.

Les avions militaires modernes dépendent largement de systèmes électroniques complexes pour les rendre efficaces dans un monde rempli de systèmes adverses également sophistiqués. Ces systèmes peuvent représenter jusqu'à 80% du prix de l'avion. Au fur et à mesure du développement de ces systèmes, de nombreux essais deviennent nécessaires pour assurer un retour d'information dans le processus itératif de conception et pour s'assurer que les spécifications sont remplies. Malheureusement, il y a peu d'écrits sur ces techniques d'essais. Même aujourd'hui, les programmes d'instruction des pilotes d'essais insistent davantage sur les aspects performances et qualités de vol alors que l'essentiel des essais en vol concerne les systèmes avioniques. Ce manuel est une tentative pour décrire les connaissances de base utiles à un pilote ou à un ingénieur d'essais pour concevoir et exécuter un programme d'essais de ces systèmes modernes qui soit rapide et d'un bon rapport qualité-coût.

# **FOREWARD**

This book is intended as an introductory document to the subject of avionics flight testing. The target reader is the novice tester, desiring an initial exposure to the subject. Reference is made throughout the book to more in-depth documents, where they exist. In practical application, the new tester should use this book as a primer and then refer to the more detailed documents relating to the class of avionics under test or to the experience of more senior testers.

The first chapter provides a detailed discussion of the content and utility of the book. Chapters two through five provide a discussion of the theory and techniques for testing airborne air-to-air and air-to-ground radar, airborne navigation systems, electro-optical systems, and stores management sets, respectively. Each chapter begins with an introduction to the theory of operation of each class of system with sufficient detail to understand the test techniques which are next presented. Each test technique is developed in a largely self-contained fashion. Chapter six is a discussion of general considerations for developing a flight test profile combining some number of the previously described techniques. Chapter seven is a detailed case study and chapter eight includes some conclusions and recommendations.

As mentioned above, this book is intended as an introductory document for the novice. As such, caution should be exercised when directly applying the techniques provided here. Further research is warranted in most cases including more advanced documents relating to the theory and testing of the class of avionics in question. Chapter one points out that adequate references do not exist for every class of avionics, in these cases, it is important to search out persons with practical experience in testing similar systems.